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RESEARCH INFORMATION REPORT TO SUPPORT DSEIS ON ENDANGERED AND THREATENED SPECIES OF SEA TURTLES, 1981

REPORT: Impact of Shrimping Tow Time on Loggerhead Sea Turtle Mortalities and Shrimp Fishery Economics

FOR: Southeast Regional Office, NMFS, St. Petersburg, FL

BY: Southeast Fisheries Center, NMFS, Miami, FL

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Impact of Shrimping Tow Time on Loggerhead Sea Turtle Mortalities and Shrimp Fishery Economics

INTRODUCTION

Since 1978, selected research has been conducted on sea turtles by SEFC, and data have been collected on (1) the relationship between mortality of sea turtles captured in shrimp trawls and the length of trawl towing time, and (2) resuscitation of comatose sea turtles. This report describes the effect the length of trawl towing time has on sea turtle mortality, and presents resuscitation results. Data indicate that reduced tow times can be considered as a means of reducing sea turtle mortality. However, reduced tow times will have a corresponding negative economic impact on the shrimp industry that must be considered. An economic evaluation of this impact -- as the cost to the shrimp industry if reduced tow time was used to protect sea turtles -- is included as a supplement to this report.

RESULTS

During SEFC field research, four hundred twenty six (426) sea turtles were captured aboard commercial shrimp trawlers. Because 95.1% of these were loggerhead sea turtles, this report refers primarily to that species. An attempt was made to revive every turtle that was brought on board in a comatose state. If resuscitation was unsuccessful, the turtle was presumed to be dead.

Data is presented by 30-minute time intervals from 30 to 270 minutes by grouping all tows that were within 15 minutes on either side of each interval. Since it was collected aboard commercial shrimp trawlers under commercial shrimping conditions, the length of drags could not be controlled by researchers. However, shrimping conditions vary from area to area and day to day, and various tow lengths occur operationally. This variation provided the opportunity to group the results into 30-minute time elements, but also restricted the interpretation of the data. For instance, dead turtles can be totaled cumulative over time, because a turtle that

was dead from a 60-minute tow would obviously be dead at a longer tow time. However, comatose turtles can also be summed this way, but with some restriction, because there is no way to know how long after it became comatose that it would have died and resuscitation would have failed.

Figure 1 presents the cumulative mortality of turtles after resuscitation failed. Table 1 lists the data that comprised the sample at each time interval. As time increases, a cumulative percentage of dead turtles is "calculated". Turtle cumulative mortality varied from 1.1% for a 60-minute tow duration, to 25.4% for a tow duration of 270 minutes. For tows of 90-minute interval and shorter produced 117 turtle captures which a total of five died, or 4.3%; at 120 minutes 184 turtle captures occurred of which 22 died, or 12.0% cumulative deaths. From regression analysis, it was determined that a linear relationship between tow length and cumulative mortality was appropriate. The equation is shown in Figure 1 and is very significant with a p-value of less than 0.001.

Since turtles captured in a comatose state have to be considered more carefully over time than dead turtles, data is presented both at the time intervals, and then cumulatively. Data at each of the time intervals is presented in Table 2. As can be seen, the actual percentage of turtles which are brought on deck in a comatose state, increases fairly rapidly. Thirty-three percent of turtles captured during tows of 60 minutes were comatose, 50% in tows of 90 minutes, and up to 88.9% at tows 270 minutes long. Table 2 also indicates how effective resuscitation procedures were in reviving turtles which were comatose. During tows 120 minutes in length, 56.7% of the comatose turtles were revived. The one turtle which died during a 30-minute tow probably represents a previously dead turtle. In fact, any turtle in a comatose state during tows of 30 minutes or less probably represents a previously dead turtle. In fact, any turtle in a comatose state during tows of 30 minutes or less probably represents previously captured, stressed or dead turtle. This condition

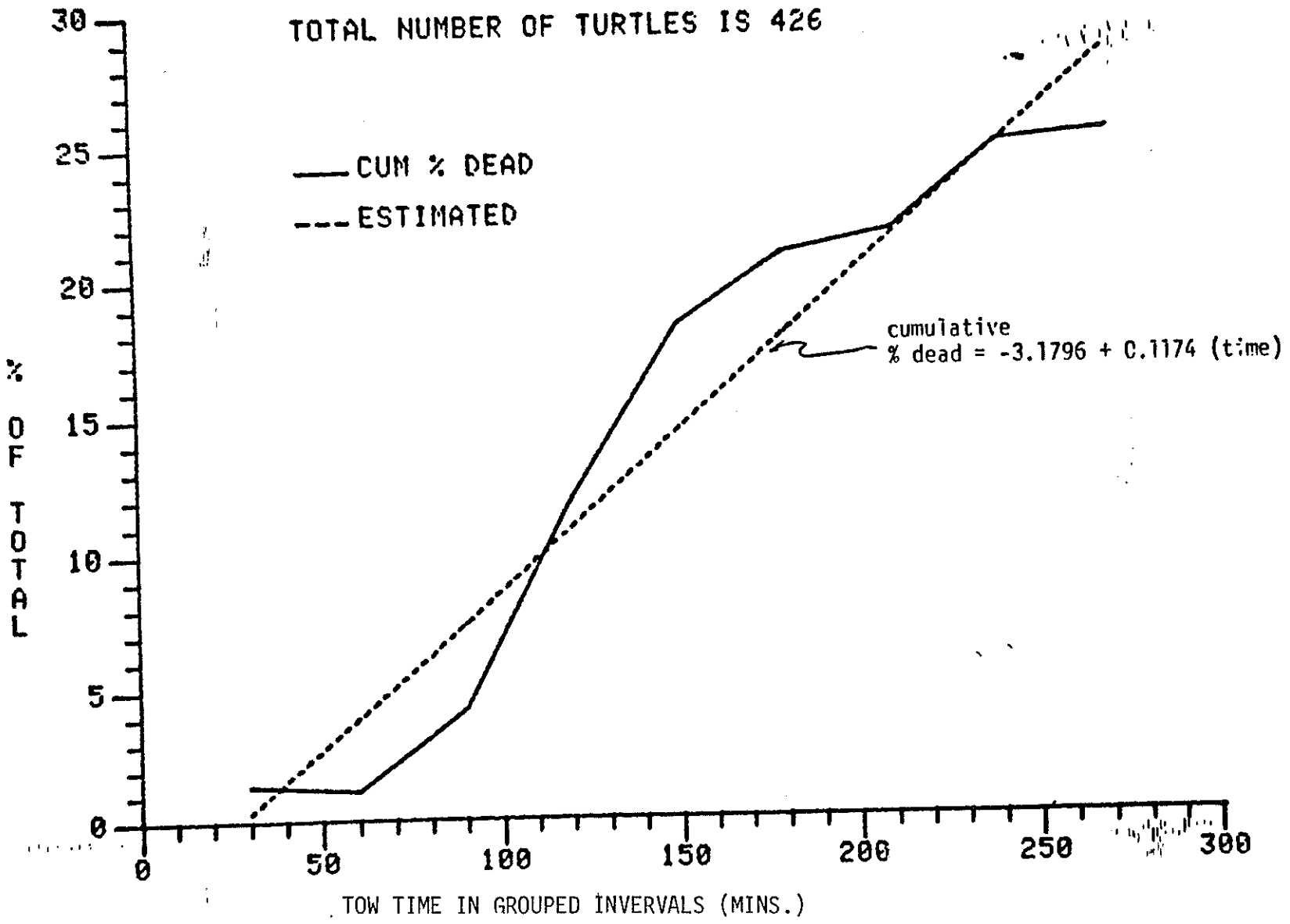

Figure 1

Figure 1. Cumulative mortality after resuscitation failure for loggerhead sea turtles with increasing shrimp trawl tow time (in cumulative percent mortality in 30-minute grouped intervals).

Table 1

Cumulative Number of Dead Turtles as a Function of Mean Trawl Time.

Time	Number in Interval	Cumulative Total	Number Dead in Interval	Cumulative Number Dead	Cumulative % Dead
30.0	74	74	1	1	1.4
60.0	15	89	0	1	1.1
90.0	28	117	4	5	4.3
120.0	67	184	17	22	12.0
150.0	73	257	25	47	18.3
180.0	83	340	24	71	20.9
210.0	43	383	12	83	21.7
240.0	25	408	19	102	25.0
270.0	18	426	6	108	25.4

Field Data showing numbers of sea turtles caught, condition of turtles, number revived and percentage of turtles comatose, revived or dead. Mean trawl time is in column 1.

Table 2

TIME	# INTERVAL	# COMATOSE	# REVIVED	# DEAD	% COMATOSE	% REVIVED	% DEAD
30.0	74	2	1	1	2.7	50.0	1.4
60.0	15	5	5	0	33.3	100.0	0.
90.0	28	14	10	4	50.0	71.4	14.3
120.0	67	38	21	17	56.7	55.3	25.4
150.0	73	43	18	25	58.9	41.9	34.2
180.0	83	47	23	24	56.6	48.9	28.9
210.0	43	24	12	12	55.8	50.0	27.9
240.0	25	20	1	19	80.0	5.0	76.0
270.0	18	16	10	6	88.9	62.5	33.3

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Field Data showing numbers of sea turtles caught, condition of turtles, number revived and percentage of turtles comatose, revived or dead. Mean trawl time is in column 1.

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30.0	74	2	1	1	2.7	50.0	1.4
60.0	15	5	5	0	33.3	100.0	0.
90.0	28	14	10	4	50.0	71.4	14.3
120.0	67	38	21	17	56.7	55.3	25.4
150.0	73	43	18	25	58.9	41.9	34.2
180.0	83	47	23	24	56.6	48.9	28.9
210.0	43	24	12	12	55.8	50.0	27.9
240.0	25	20	1	19	80.0	5.0	76.0
270.0	18	16	10	6	88.9	62.5	33.3

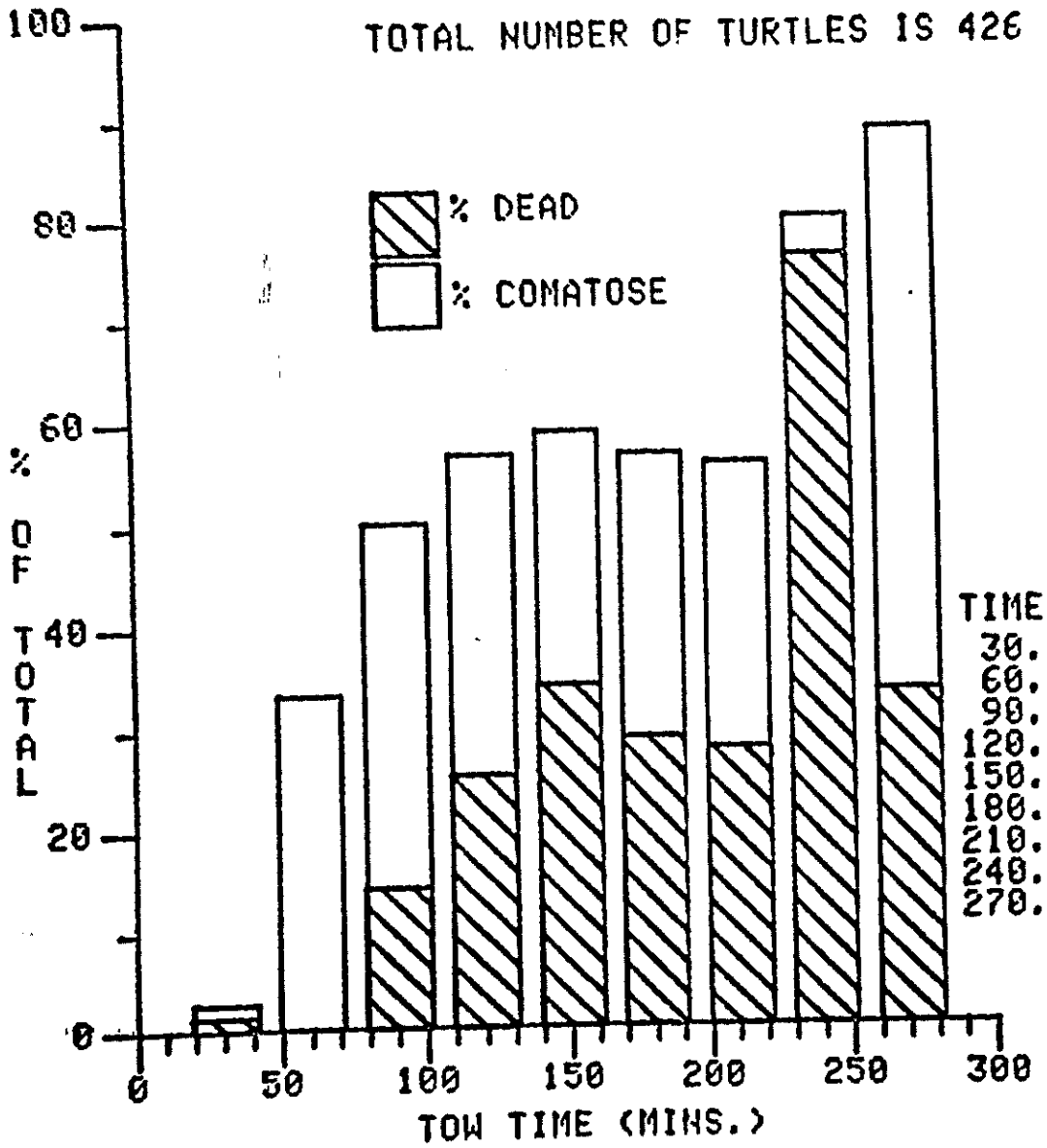
is certainly a factor in sea turtle survival on commercial shrimp grounds, and the condition is inherent in the data presented. However, actual numbers in this condition cannot be separated from the total data. Other sources of sea turtle work, however, such as habitat surveys in Cape Canaveral, and the sea turtle rescue operation at Cape Canaveral (summer 1980) has resulted in over 1,200 captures in tows of 30 minutes or less, and never produced a dead turtle.

Figure 2 is a presentation of the interval data graphing the percentage of turtles captured that were comatose at the various time intervals, and the resulting percentage of turtles which were dead after attempted resuscitation. The difference between the two is how effective resuscitation was at each tow length interval.

Cumulative data is presented in Table 3. On this basis, of the number of turtles captured in all tows up to 90 minutes in length, 17.9% were comatose; up to 120 minutes in length 32.1% were comatose and so on. A graphical comparison between cumulative dead and cumulative comatose is shown in Figure 3. The difference between the two curves is again the effectiveness of resuscitation, but reflected cumulatively.

The two methods of assessing comatose turtles should be compared. If all commercial shrimp drags were one fixed length, then the data presented on an interval basis represents the effect on sea turtles for the selected tow length. However, if an operational variation in tow time length would continue to occur even with a fixed maximum tow length, i.e. tow lengths shorter than the maximum would still occur, then the cumulative approach could be used to evaluate the effect different tow lengths would have on sea turtles.

From the data presented, restricting tow lengths to times shorter than the current commercial shrimping practice would be effective in reducing sea turtle mortality, if resuscitation is used. At tow lengths up to 90 minutes, 71.4% or more of comatose turtles can be revived. On an interval basis, this then results in a mortality of 14.3%. On a cumulative basis, including tows shorter than 90 minutes, mortality could be as low as 4.3% as was shown in Table 1.



TIME	%DEAD	%COMA	#INT	TOTAL
30.	1.4	2.7	74	74
60.	0.	33.3	15	89
90.	14.3	50.0	28	117
120.	25.4	56.7	67	184
150.	34.2	58.9	73	257
180.	28.9	56.6	83	340
210.	27.9	55.8	43	383
240.	76.0	80.0	25	408
270.	33.3	88.9	18	426

Figure 2. Comparison of the percentage of comatose and dead turtles at mean tow times after resuscitation.

Table 3

Field Data Showing Number of Cumulative Comatose Turtles and Cumulative Percent of Comatose Turtles in each Mean Trawl Time Interval.

Time	Number in Interval	Cumulative Total	Number Comatose in Interval	Cumulative Number Comatose	Cumulative % Comatose
30.0	74	74	2	2	2.7
60.0	15	89	5	7	7.9
90.0	28	117	14	21	17.9
120.0	67	184	38	59	32.1
150.0	73	257	43	102	39.7
180.0	83	340	47	149	43.8
210.0	43	383	24	173	45.2
240.0	25	408	20	193	47.3
270.0	18	426	16	209	49.1

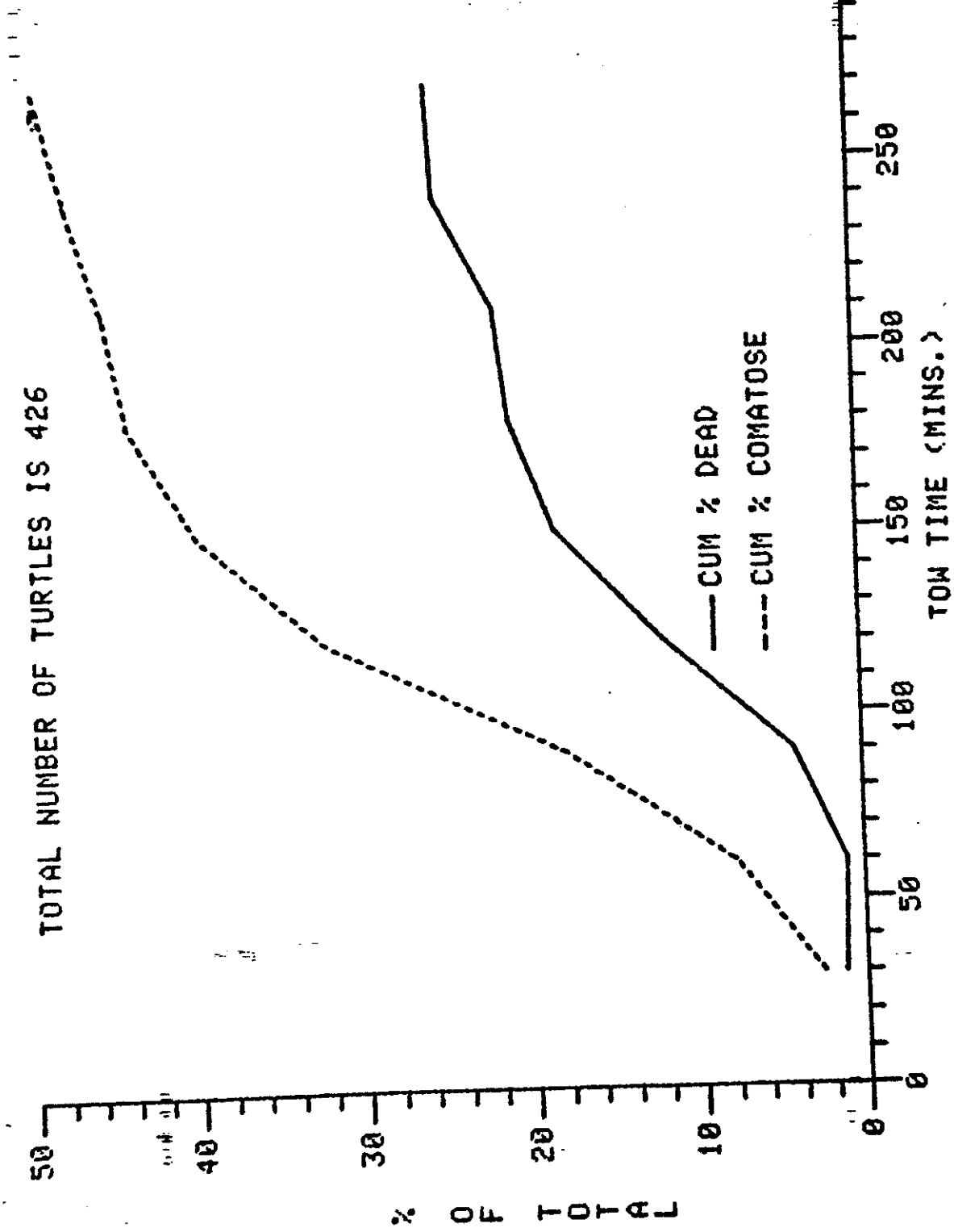


Figure 3. Cumulative mortality with resuscitation for loggerhead sea turtles with increasing shrimp trawl tow time. Presented as cumulative percent dead and cumulative percent comatose in 30-minute grouped intervals.

Reducing tow times to some length less than current average commercial tows would affect the economics of shrimping. Attached is a supplemental report evaluating the impact tow times of 60, 90 and 120 minutes would have. The cost analysis is based on vessels from South Carolina and the Padre Island area of Texas. Since vessels in South Carolina, Georgia and East Florida are generally similar in size and construction, the economic impact detailed for South Carolina can be used to represent the South Atlantic. Texas boats, on the other hand, can be assumed to be representattive of the Gulf of Mexico. There would probably be some variation between areas of the Gulf of Mexico, but overall the economic impact detailed by Texas vessels would be fairly representative.

The economic evaluation was based on the assumption that length of actual bottom fishing time in the South Atlantic was 7.5 hours during a day and 12 hours a day for the Gulf of Mexico. It was further assumed that the total fishing time per day was a fixed amount. This assumption is probably fairly valid, particularly for the South Atlantic where tidal conditions and other factors control the availability of shrimp. In the Gulf, however, some compensation for time loss might be possible, but as a rule the availability of brown and pink shrimp is restricted to nighttime and thus controlled by day/night ratios.

SUPPLEMENT TO REPORT: Impact of Shrimping Tow Time on Loggerhead Sea Turtle Mortalities and Shrimp Fishing Economics

Preliminary Estimate of the Economic Cost of Reduced Tow Times and of the Use of Excluder Devices

Preliminary estimates of the economic cost of reduced tow times and of the use of excluder devices designed to reduce capture of sea turtles by the Southeast shrimp fishery are provided. In preparing this estimate we made use of preliminary data furnished by TIMS and the Mississippi Laboratories of NMFS as well as readily available economic data on costs and earnings of the Southeast shrimp fishery. An in-depth study on the economic feasibility of the turtle excluder trawl is underway and a final report on the project is scheduled for June 1981. This final report, will incorporate better documented data on both biological and fishing gear parameters and will include a more rigorous economic analysis.

The questions we set out to answer were:

- What is the economic cost of using reduced tow times (specifically 60 minutes, 90 minutes, and 120 minutes) as compared to normal tow times?
- What is the economic cost of using excluder devices (specifically excluder panels and escape doors)?

Because of the short time frame, we limited consideration to two areas and one season:

- off Padre Island, TX (April-November)
- off South Carolina (April-October)

These areas and seasons were selected because we understand that the incidental capture of sea turtles is highest in these places and at these times. Some estimates of the costs for larger geographical areas can be made, but should be done cautiously.

Several considerations were applied to the data used. Cost-earnings data were taken from "Financial Aspects of Louisiana Shrimp vessels, 1978" (K. J. Roberts and M. E. Sass, Louisiana State University 1979), which are the latest data available. Shrimp vessels were divided into three groups: small (50 ft or less), medium (51-65 ft), and large (more than 65 ft). In these cost calculations, the compensation to the captain is not included in crew shares. This method was used due to the mixture of owner-operation and hired captains. Therefore, compensation to captain is included under net profit. In this study, average fishing days per year were found to be 115 for small vessels, 136 days for medium vessels, and 196 days for large vessels. In addition to the above economic data, we assumed the following fishing practices:

1) South Carolina

   Length of fishing day - 7.5 hours[1/]

   Average length of tow - 2.5 hours

2) Texas

   Length of fishing day - 12 hours[1/]

   Average length of tow - 4 hours

We assumed the following costs:

	Initial Cost	Average Maintenance Cost
Excluder Panel	$250	$48
Escape Device	$200	$96

Calculations were made as follows:

A. Costs of reduced tow times

It was considered that the principal effect of reduced tow times was to reduce the amount of effective bottom fishing time, given that the total fishing time per day was a fixed amount. The requirement of shorter tows resulted in a decrease in effective fishing time,

1/ In addressing shrimp harvesting, only trawl bottom time is considered.

due to the greater number of times that the gear would be hauled back and reset. We assumed that the turnaround time for setting and haulback was 15 minutes for South Carolina and 20 minutes for Texas. This resulted in the following change in effective fishing time as compared to normal fishing practices:

Reduced Tow Time (minutes)	% Decrease in Effective Fishing Time	
	South Carolina	Texas
60	17	27
90	7	15
120	3	9

We further assumed that these reduced tow times would result in reduced gross revenue in the same proportion as the reduction in fishing time. Net profit would also be reduced, but in a different proportion, as determined by the effect of reduction in crew shares. These calculations are summarized below, using the financial statements for the three categories of Louisiana vessels.

Area	Size of Vessel	Tow Time (Minutes)	% Reduction in Gross Revenues (and in crew shares)	% Reduction in Net Profit
South Carolina	Large	60	17	46
		90	7	26
		120	3	10
	Medium	60	17	32
		90	7	14
		120	3	7
	Small	60	17	45
		90	7	19
		120	3	8
Texas	Large	60	27	70
		90	15	41
		120	9	27
	Medium	60	27	49
		90	15	27
		120	9	16
	Small	60	27	70
		90	15	39
		120	9	23

B) Cost of excluder devices

It was considered that the principal effect of excluder devices was to change catch patterns and to add the cost of the devices. We assumed that the excluder panel reduced catches by 15% and that the trap door did not reduce catch, based on information supplied by the Mississippi Laboratories. Costs of the devices are listed above.

Base on these assumptions, the following effects on vessel costs and earnings were predicted:

	Excluder Panel		Escape Device	
Size of Vessel	% reduction in gross revenue	% reduction in net profit	% reduction in gross revenue	% reduction in net profit
Large	15	41	0	0.6
Medium	15	27	0	0.8
Small	15	39	0	2.4

Total landings for the respective areas and time periods are given below:

Area	Year	Pounds (1,000)	Value ($1,000)
South Carolina	1978	2,684	7,823
South Atlantic	1978	4,474	11,537
Texas	1978	43,839	114,455
Gulf of Mexico	1978	125,887	254,092

It should be noted that these landings (heads-off) and value data are for the months of April through October for South Carolina and the total South Atlantic and for April through November for Texas and the Gulf of Mexico.

Care should be used in extropolating any effects of reduced tow times on total catches.

Summary

The results indicate that all proposed methods will have an effect on net revenue from the shrimp fishery. The trap door would have the least effect, the excluder trawl would have an intermediate effect, and the reduced tow time would have the greatest effect.

We have not attempted to extrapolate total costs to the Texas or South Carolina areas or to large areas, based on these preliminary data.